1. PROJECT CODE SA-AMS	2. JPIC CODE AMS	AMS-02 TASK SHEET (ATS)		

3.	A	CONFIGURATION CHANGE	☒	4. ATS NO. TRD 090522-1	5. PAGE 1 OF 15
T Y P E	PERMANENT ☒ TEMPORARY		☐	6. MOD SHEET(S) NUMBER(S)	
	B	NONCONFIGURATION CHANGE	☐		

10. PART NAME TRD_GAS_XE_FLIGHT_FILL	11. Sub Detector Name TRD_GAS_SUPPLY_SYSTEM	12. SERIAL/LOT NO.

14. APPLICABLE DOCUMENTS

18. ATS TITLE
TRD_GAS_SUPPLY_SYSTEM_XENON_VESSEL_FILLING_FOR_FLIGHT

20. OPER SEQ. NO.	21. OPERATIONS (Print, Type, or Write Legibly)	VERIFICATION	
		22. TECH	23. QA/DV
	The steps of this ATS may be worked out of order with the cognizant project engineer's approval.		
	This ATS describes the necessary steps to fill the TRD-GAS Xenon vessel with high purity Xenon, to be used for flight.		
	The TRD-GAS Xenon Vessel is a Composite Overwrapped Pressure Vessel (COPV) and has to be handled in agreement with the COPV protection plan ESCG-4390-09-SP-MEMO-0002		
	For this operation the protective covers will remain installed on the COPVs.		
	A full pressure history log will be kept for the COPVs		
	For the full duration of the filling procedure two persons will be present:		
	Name: _Thorsten Siedenburg_		
	Name: _Feng Zhou_		

24. ORIGINATOR Thorsten Siedenburg	DATE	25. FINAL ACCEPTANCE STAMP AND DATE

APPROVALS *(Printed or Typed and Signed)*

26. PROJECT ENGINEER Feng Zhou	DATE	27. QUALITY ENGINEER Thorsten Siedenburg	DATE 18-6-09
28.		29. DV Ken Bollweg	
30.		31.	

AMS Assembly Task Sheet (ATS) Rev 9/25/06 JH

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Figure 1 TRD-GAS-SYSTEM

1. Open this ATS.

2. <u>**Verify Xenon and CO2 Tanks covers are in place and properly fixed before proceeding in the steps of this procedure**</u>.

    NOTE: This operation MUST be exclusively performed by Maurice Vergain and/or Feng Zhou.

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Subtract from 3.a : 2.6 ~~kg~~ kg ← (55.9 bar ~~...~~ Ar in Xe Vessel 20.2°C

3.
a   Weigh BoxS (in Transport-Frame) TRD-GAS: (108,10 kg)
    on Sartorius scale (150kg max with 50g sensitivity) 10 5,5 kg
    include Fill-Port inner plug and outer cap with gaskets
b   Calibration weight 6,93 kg

c   add calibration weight on scale: 115,00 kg   TS   FZ
    Designated Verification by NASA: 18.6.

4.   Check Gas Bottles

a CO_2 Purity 4.8   has to be >= 4.8

b   Weigh bottle on scale   Total: 96,80 kg

    Bottle: 67,90 kg

    Net: 28,9 kg   has to be > 25kg

c   Xenon Purity 5,0   has to be >= 4.8

d   Weigh bottle on scale   Total: 92,25 kg

    Bottle: 64,45 kg

    Net: 27,8 kg   approx 27kg   TS   FZ
                                  18.6.

5.   Setup Xenon Bottle

a   put bottle on scale (Sartorius 150kg max, 50g sensitivity)
b   secure bottle against tipping over
c   attach 2m heater tape (500W at 230V) at bottom of bottle
d   attach heater-control temp.sensor at bottle 50cm above heater tape
e   connect heater tape and temp.sensor to heater control (HORST HT31)
f   attach Pt100 temp.sensor to top part of bottle
g   connect Pt100 temp.sensor to NUDAM readout
h   connect 100bar pressure reducer to bottle   18.6. 17:30   TS   FZ

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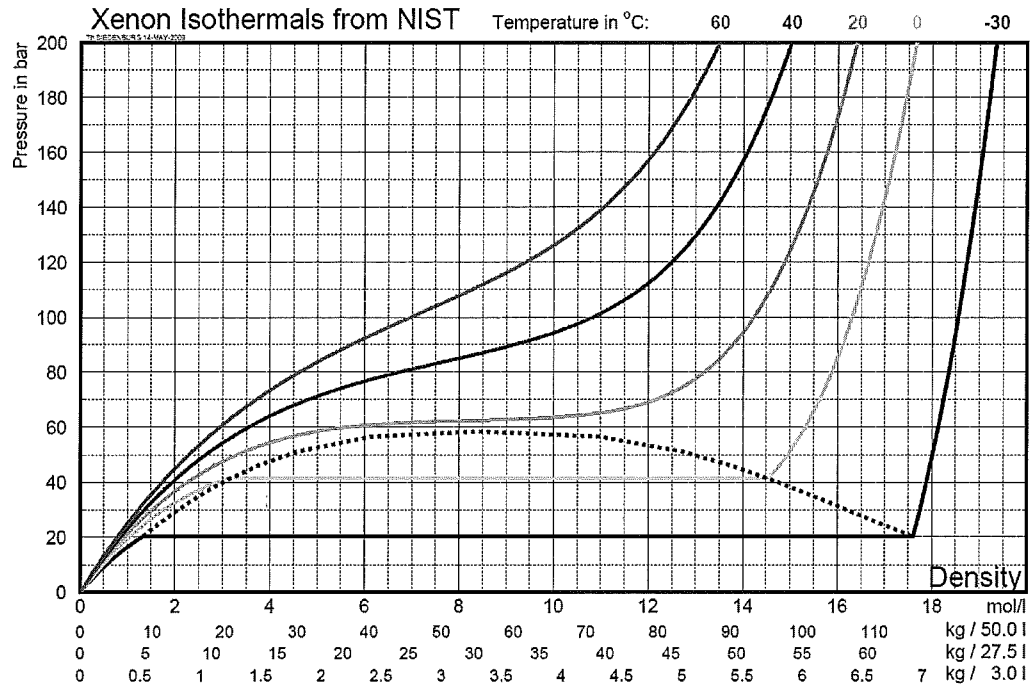
Figure 2 Xenon Pressure vs. Mass for 50l, 27.5l and 3l vessel
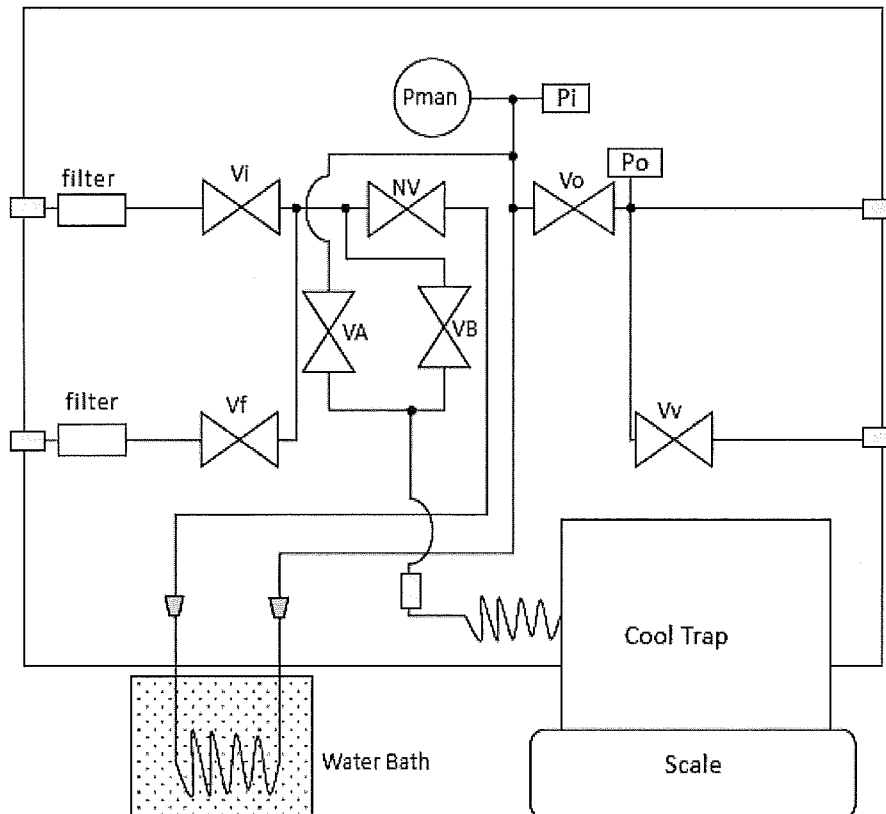
Figure 3   Gas Transfer Panel Schematic

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Figure 4   Gas Transfer Panel

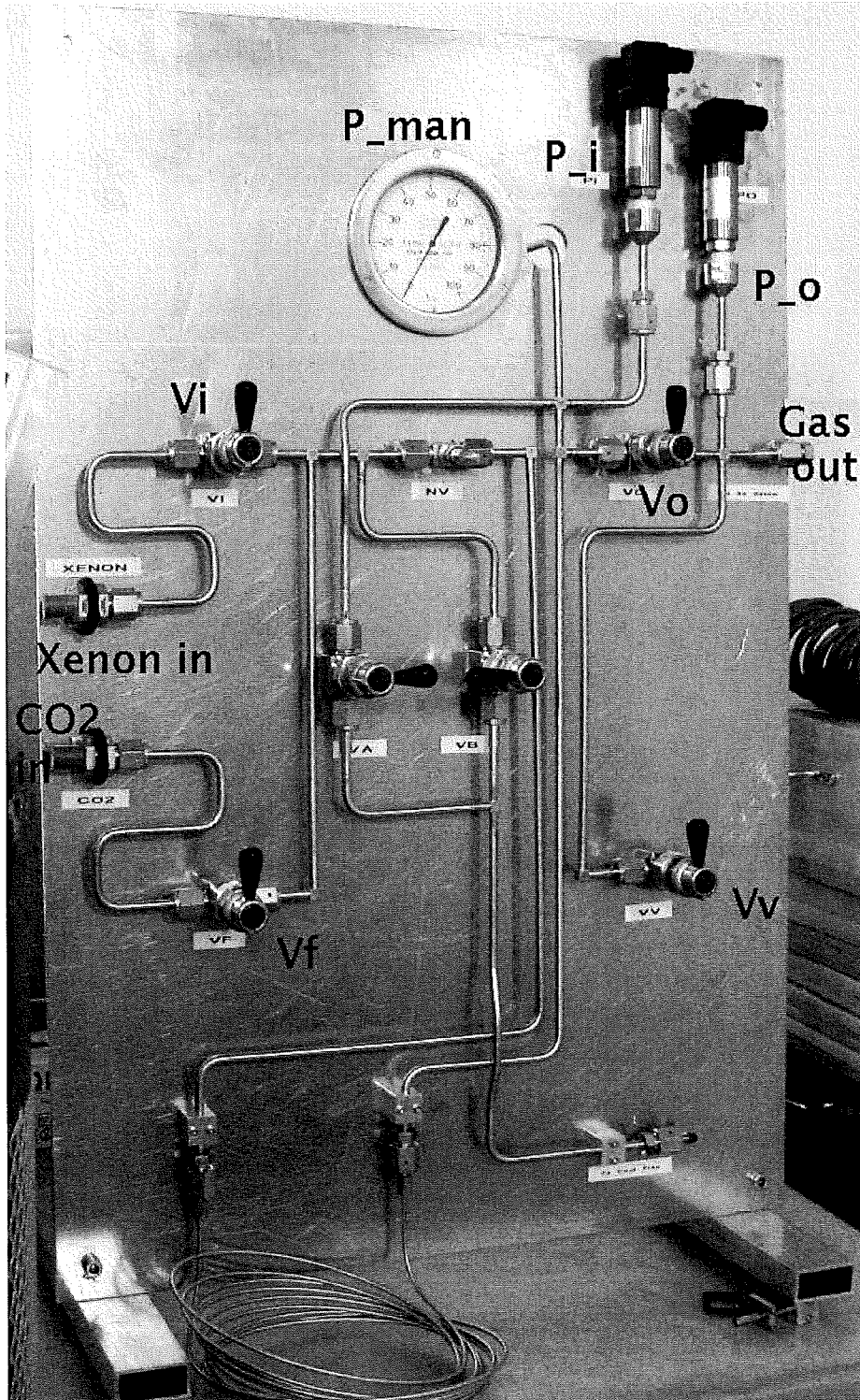| AMS-02 TASK SHEET (ATS) CONTINUATION PAGE	4. ATS NO.	TRD 090522-1
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6. Test Cool Trap Thermostat

Figure 5 Thermostat and Cool-Trap on Scale

a   start NUDAM readout (T_bottle/T_cooltrap/P_i/P_o)   18.6.
b   check that coolant level is at red dot and switch on thermostat
c   set temperature to -25 degC   time: 14:15
d   record time when coolant has reached -25 degC   time: 14:30
e   record time when Tct has reached 0 degC   time: 14:35
f   set temperature to +40 degC   time: 14:35
g   record time when coolant has reached +40 degC   time: 15:10
h   record time when Tct has reached +20 degC   time: 15:15
i   switch off Thermostat

TS   FZ

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7. Connect CO_2 Bottle to panel

a close all panel shutoff valves (Vf, Vi, Va, Vb, Vo, Vv)
b connect vent tube to panel vent connector at panel valve "Vv"
c check that water in water-bath covers the gasline loops
d connect line with Fill-Port adaptor to panel "Gas out" with new gasket
   VCR connections are closed hand-tight plus a 45 degree turn
e blindplug Fill-Port adaptor with test fill-port
f connect CO_2 bottle to panel "CO_2" connector with new gasket
g open bottle main valve
h record CO_2 bottle main pressure gauge (57±2bar) _55_ bar
j open pressure reducer to above 57bar
j record   pressure reducer gauge (57±2bar) _52_ bar
k open panel valves "Vf" and "Vo" + Va + Vβ
l record   P_man _52.1_ bar

          P_i   19-JuN 01:00 _52.14_ bar 21.9°C

          P_o   _52.01_ bar
     all three should read same as bottle pressure gauges
m close CO_2 bottle main valve   time/temp.: 18-JuN 18:00 22.5°C

n wait for 1 h and then   time/temp: 19-JuN 9:00 21.5°C

     record CO_2 bottle main pressure gauge _55_ bar

          pressure reducer gauge _52_ bar ✓

          P_man _52.0_ bar

          P_i   19-JuN 06:00   _52.02_ bar 21.5°C

          P_o   _51.89_ bar
     pressure drop wrt. 7.h, 7.j and 7.l must be below 20mbar/h *
     if above check gas connections at bottle and panel and resume at 7.d
o set CO_2 pressure reducer to 0
p close panel valve "Vf"
* P_{drop} 110 mbar / 5h
     T_{drop} = 0.4°C ≙ 80 mbar at 52 bar.   ✓   Vb   TZ

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		22. TECH	23. QA/DV

20. OPER SEQ. NO.	21. OPERATIONS
8.	**Connect Xenon Bottle to Panel**

a connect Xenon bottle to panel "XENON" connector with new gasket
   but do not tighten connector

b open panel "Vi" partially and vent panel to ambient pressure
   with valve "Vo" open

c tighten XENON connector at panel at end of venting

d read Xenon Bottle weight on scale __96.50__ kg

e open bottle main valve

f record Xenon bottle main pressure gauge (55±2bar) __54__ bar

g open pressure reducer to above 55bar

h record Xenon pressure reducer gauge (55±2bar) __53__ bar

i record P_man _____ bar

              P_i _____ bar

              P_o _____ bar

   all three should read same as bottle pressure gauges

j close Xenon bottle main valve   time/temp.: *18-Jun 18:00* 22.5°C

k wait for 1 h and then   time/temp.: *19-Jun 9:00* 21.5

   record Xenon bottle main pressure gauge   __54__ bar

        Xenon pressure reducer gauge   __53__ bar ✓

        P_man _____ bar

        P_i _____ bar

        P_o _____ bar

   pressure drop wrt. 8.f, 8.h and 8.i must be below 20mbar/h
   if above check gas connections at bottle and resume at 8.a

l set Xenon pressure reducer to 0

m open panel "Vv" and vent panel to ambient pressure
   with valves "Vi" and "Vo" open

n open Xenon pressure reducer for 10s to flush Xenon inlet line

o close panel vent valve "Vv"

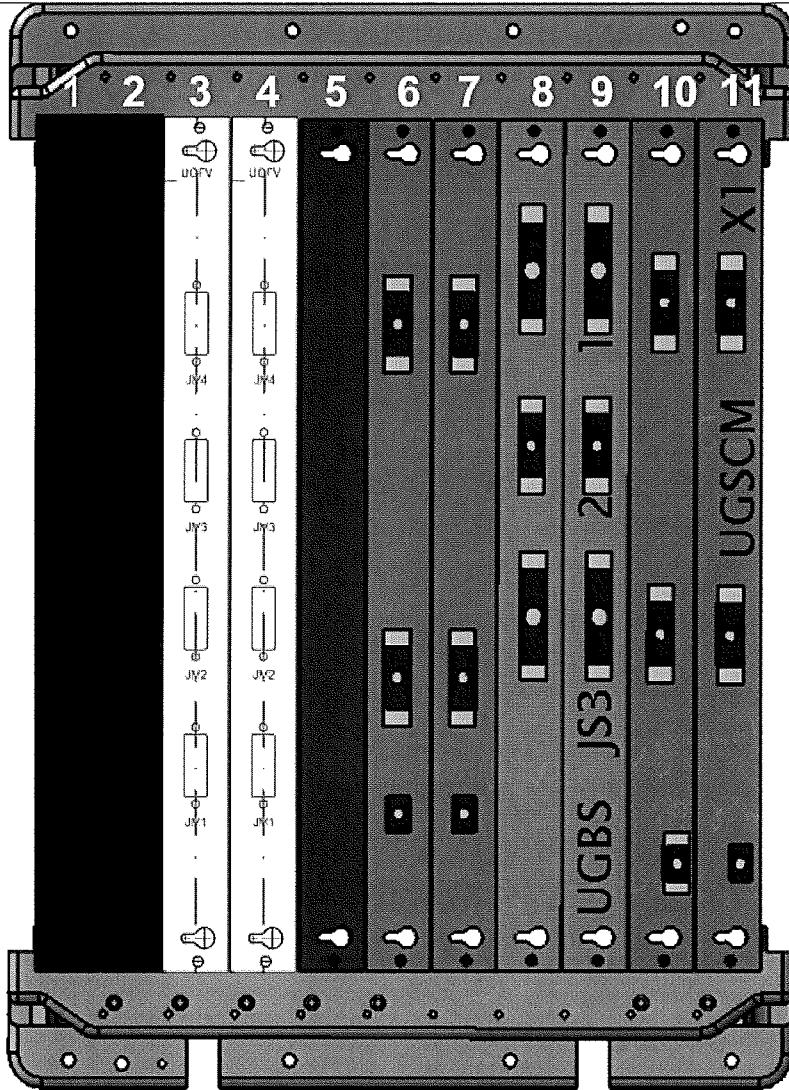| AMS-02 TASK SHEET (ATS) CONTINUATION PAGE	4. ATS NO.	TRD 090522-1
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9. Set up UG-Crate Readout

Figure 6   UG-Crate Frontpanel

a   connect UG-Crate to PC and power and switch on

b   check UGSCM readout and UGBS readout

c   connect DTS cable to UGSCM X1 and BoxS GDTS / JS2-A / JS2-B

d   check DTS readout (GDTS-A/B LDTS-A/B)

e   connect BoxS JS3-A to UGBS-A JS3 with QM cable

f   check readout of P1a and P1c

g   start continuous logging of BoxS DTS and pressure sensors   time: _____

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10. Test Xenon Bottle Heating

a With Heater-Control powered off,

set Heater Control Tset to 20 degC

set Heater Control Power to 0%

b Switch on Heater Control

c record ambient temperature from T_heater / T_bottle: _23_ / _22,4_ degC

both should agree with room temp. within 2degC

d open bottle main valve with reducer at 0 (closed)

bottle main pressure gauge should read 55bar

reducer outlet pressure gauge should read 0

panel P_man, P_i and P_o should also read 0   _18.6._

e set Heater control to 40degC and 100% Power   time: _9:42_ degC: _22.4_

f monitor T_heater, T_bottle and bottle main pressure

if xenon bottle main pressure goes above 100 bar, abort to 10.j   _38 (0_

time when 40degC are reached   time: _10:52_ degC: _$_

g record bottle main pressure   _63_ bar

should reach 65bar (27kg)

h record reducer outlet pressure   _63_ bar

P_man   _1.0_ bar

P_i   _0.98_ bar

P_o   _0.97_ bar

all four readings 8.h should all stay at ambient (1bar) within 0.5bar

i close panel valves "Vi" and "Vo"

j turn off heater   date _18.6_ time _10.52_   _TS_   _FZ_

k if bottle main pressure is below 100 bar close bottle main valve

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		22. TECH	23. QA/DV

20. OPER SEQ. NO.	21. OPERATIONS
11.	Flush Xenon Vessel and Cool-Trap with CO2
	a remove blind-plug from Fill-Port adaptor
	b open CO2 bottle main valve
	c open pressure reducer to above 57 bar
	d open panel valves "Vf", "Vo" and "Vv" and flush CO2 for 30s
	e close panel valves "Vf" and "Vv"
	f connect Fill-Port to BoxS Xenon vessel, close cap handtight only
	g open panel valves "Va" and "Vb"

In case of Power-Failure during the following steps 11.x and 12.x:
Close CO2 and Xenon bottle main valves, Close panel valves "Vi", "Vf", "Vo"

11.1.1

a open panel valve "Vf"   19-JUN   11:11

b pressure up Xenon vessel to 55bar   49,3 bar
   monitor P_man, P_i, P_o, P1a, P1c

c close panel valve "Vf" when Xenon vessel is at 55bar   11:51

d keep pressurized until Xenon vessel DTS stabilize to 0.1degC
   if left unattended, then close bottle main valve: time _____

time	T_000A /B	T_090A /B	T_180A/B	T_270A/B	T_bossA/B
11:51	32.3 / 32.5	28.1 / 28.1	21.7 / 21.6	27.4 / 27.3	20.9 / 20.8
13.13	24.9 / 25.1	23.75 / 23.9	22.1 / 22.0	23.7 / 23.8	21.0 / 21.0
18.00	20.8 / 20.9	20.8 / 20.7	20.7 / 20.6	20.8 / 21.0	20.9 / 20.9
19:00	20.8 / 20.9	20.8 / 20.9	20.7 / 20.7	20.8 / 21.0	20.9 / 20.9

e record pressure sensors P_o, P1a, P1c for at least one hour:

time	P_o	P1a	P1c
19:00	47.14	47.22	47.23
2:23	47.12	47.22	47.21

20-JUN
   pressure drop should be below 20 mbar per hour   <20mbar /7h ✓
   if above, then check Fill-Port adapter O-rings and resume at 11.d

f open panel valve "Vv" to vent Xenon vessel and Cool-Trap   20-JUN 09 10:02

g close panel valve "Vv" when pressure P_o has reached 1.2bar   1.0   10:52

h "Tare" Cool-Trap scale to 0   TB   FZ

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		22. TECH	23. QA/DV
11.1.2	a open panel valve "Vf" 20-JUN-09 time: ~~15:3~~		
	b pressure up Xenon vessel to 50bar 11.22		
	monitor P_man,P_i,P_o,P1a,P1c		
	c when P_o > 50bar close panel valve "Vf" P_o: 52.2 bar time: 11:50		
	d record Cool-Trap scale (should be around 400g) Mct: 500 g		
	e open panel valve "Vv" to vent Xenon vessel and Cool-Trap time: 11:52		
	f when P_o < 1.2bar close panel valve "Vv P_o: 1.0 bar time: 12:30		
	g record Cool-Trap scale (should be 0g) Mct: ~~30~~ 0 g		
11.1.3	a open panel valve "Vf" time: 14:54		
	b pressure up Xenon vessel to 50bar		
	monitor P_man,P_i,P_o,P1a,P1c		
	c when P_o > 50bar close panel valve "Vf" P_o: 54.7 bar time: 15:30		
	d record Cool-Trap scale (should be around 400g) Mct: 530 g		
	e open panel valve "Vv" to vent Xenon vessel and Cool-Trap time: 15:31		
	f when P_o < 1.2bar close panel valve "Vv P_o: 1.0 bar time: 17:11		
	g record Cool-Trap scale (should be 0g) Mct: 0 g		
11.1.4	a open panel valve "Vf" time: 17:12		
	b pressure up Xenon vessel to 50bar		
	monitor P_man,P_i,P_o,P1a,P1c		
	c when P_o > 50bar close panel valve "Vf" P_o: 50.7 bar time: 17:44		
	d record Cool-Trap scale (should be around 400g) Mct: 490 g		
	e open panel valve "Vv" to vent Xenon vessel and Cool-Trap 26-JUN time: 10:49		
	f when P_o < 1.2bar close panel valve "Vv P_o: 1.0 bar time: 14:45		
	g record Cool-Trap scale (should be 0g) Mct: 0 g		
	h close CO2 bottle main valve and pressure reducer	TS	FF
12.	Fill Xenon Vessel		
	Transferring 20 kg of Xenon out of the source bottle containing 27 kg into the Xenon Vessel requires execution of steps 12.1, 12.2a, 12.2b and 12.2c		

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12.1	**Fill Xenon Vessel Step 1 - without Cool-Trap**		
	a record Xenon bottle weight _96.85_ kg		
	b close panel valves "Va" and "Vb" to start without Cool-Trap		
	c turn on Xenon bottle heating to 40 degC at 100% power 59°C 71 bar		
	d open Xenon bottle main valve and pressure reducer to above 60 bar		
	e open panel valve "Vi" 26-JUN 11:53		
	f close panel valve "Vo" when P_o stabilizes time: _13:23_ P_o: _52.8_ bar		
	g record Xenon bottle weight _85.80_ kg		
	bottle should have lost around 10kg wrt. 12.1a		
12.2a	**Fill Xenon Vessel Step 2a – with Thermostat driven Cool-Trap**		
	a "Tare" Cool-Trap scale to 0		
	b open panel valve "Va"		
	c switch on Thermostat _13:59_		
	d set Thermostat to -25 degC and transfer 5kg Xenon into Cool-Trap		
	e when Mct = 5.0kg close panel valves "Vi" and "Va" time: _14:53_		
	f record Xenon bottle weight (should be 5kg less than 12.1g) _80.80_ kg		
	g open panel valves "Vb" and "Vo" _when P_1 > P_o_ 15:20 51.5 bar		
	h set Thermostat to +40 degC and empty Cool-Trap into Xenon vessel _14:54_		
	i when transfer ends, record time: _16:15_ Mct: _1.7_ kg P_o: _58.6_ bar 28°C		
	j close panel valves "Vb" and "Vo"		
12.2b	**Fill Xenon Vessel Step 2b – with Thermostat driven Cool-Trap**		
	a set Thermostat to -25 degC time: _16:16_		
	b when P_i < P_xe_bottle, open panel valve "Va" 37.1 bar time: _16:27_		
	c fill at most 5kg Xenon into Cool-Trap		
	d when done close panel valves "Vi" and "Va" time: _17:52_ Mct: _5.3_ kg		
	e record Xenon bottle weight (should be max.5kg less than 12.2a-f) _77.0_ kg		
	f open panel valves "Vb" and "Vo" _when P_1 > P_o_ 18:30 59.6 bar		
	g set Thermostat to +40 degC and empty Cool-Trap into Xenon vessel _17:54_		
	h when transfer ends, record time: _19:20_ Mct: _1.7_ kg P_o: _62.0_ bar 25°C	TS	FF
	i close panel valves "Vb" and "Vo"		

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12.2c	Fill Xenon Vessel Step 2c – with Thermostat and liquid nitrogen driven Cool-Trap		
	a set Thermostat to -25 degC 27-Jun time: 9:30		
	b when P_i < P_xe_bottle, open panel valve "Va" 24.4 time: 10:15		
	c when Mct stabilizes record Mct: 20 kg Tct: -20 degC time: 10:28		
	d with cup and funnel pour liquid nitrogen into Cool-Trap in steps of 100g 15x70g		
	until Tct=-40 degC or Mct=5kg Tct: -40 degC Mct: 3.8 kg		
	e when done close panel valves "Vi" and "Va" time: 12:23		
	f record Xenon bottle weight 74.75 kg		
	g open panel valves "Vb" and "Vo" when P_i > P_o		
	h set Thermostat to +40 degC and empty Cool-Trap into Xenon vessel 17:09		
	i when transfer ends, record time: 18:58 Mct: 1,1 kg P_o: 62,4 bar		
	23,2°		
	j close panel valves "Vb" and "Vo"		
12.3	Finish Xenon Filling		
	a switch off Cool-Trap Thermostat		
	b switch off Xenon bottle heater - set to 0degC and 0% power		
	c close Xenon bottle main valve if pressure is below 100bar		
	d disconnect fill-port adaptor from BoxS Xenon vessel fill-port		
	e close inner fill-port plug with new gasket running torque: * 3,0 Ncm Nm		
	f weigh BoxS on scale in same configuration as step 3. 126.10 kg		
	MASS OF TRANSFERRED XENON (12.3f. – 3.) 20.60 kg	TS	TZ
	Designated Verification by NASA:		
	+ 6.9% : 133.0 Kg		
	* TOHNICHI DB3N4 Ser.No. 317981V		

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13.	Verify gas tightness of Xenon fill-port inner cap		
	a mount outer Xenon Fill-Port cap with pressure sensor with new gasket		
	b connect pressure sensor P_cap to NUDAM readout		
	c monitor pressure P_cap for one hour, then remove outer cap		

28.6.09

time		0:00	5:00		

P_cap		973,5	973,5		

pressure increase should be below 1 mbar per hour

if above, then replace VCR gasket of inner Fill-Port plug

use new inner Fill-Port plug   running torque: _____ Ncm

resume at 13.a   N.A.

d install outer fill-port flight cap with new gasket – handtight plus 45 degree

e mark position of outer fill-port cap wrt. fill-port housing with Sharpie Pen

and attach Tag "Do not open. Contains Flight Xenon. Secure before flight"

14	Enter recorded data on TRD-GAS COPV Pressurization History sheet	TS 28.6.09	FZ
15	Close this ATS		